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AUTHOR Vaughan, Joseph L., Jr.; And Others
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ABSTRACT

Thirty-six students participated in a study of a program designed to help first-year medical students construct an ideational scaffolding as they attempted to understand their texts. They were divided into two groups: an experimental group that was given an instructional program on how to develop a hierarchical structure while reading, and a control group that received no instruction. At the end of the instructional period, the control group and the experimental group were given a reading assignment and a comprehension test. It was found that the total test score for the experimental group was higher than the score for the control group, that there was no significant difference between the two groups on scores on higher-level and middle-level concept categories, and that the experimental group did significantly better on the lower-concept category. A surprising result was that although most of the students in the experimental group were observed to construct on paper a structured overview as they read, there were no differences in the words-per-minute for the reading task between the two groups. (TJ)

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Joseph L. Vaughan, Jr.
Reading Department
University of Arizona
Tucson, Arizona 85721

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Joseph L. Vaughan, Jr., Ed.D.
University of Arizona

Paula L. Stillman, M.D.
University of Arizona

Darrell L. Sabers, Ph.D.
University of Arizona

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Construction of Ideational Scaffolds During Reading

The issue of reading comprehension has been an on-going concern of pedagogical researchers for decades. In recent years, investigations into reading comprehension have been given new impetus as a result of a renewed interest in the area of cognitive psychology. Of special import has been the notion that reading comprehension is largely determined by the prior knowledge that a reader brings to a given reading activity.

The basis for this notion comes predominantly from Bartlett (1932) and is expressed by Ausubel (1968) as "...new ideas and information are learned and retained most efficiently when inclusive and specifically relevant ideas are already available in cognitive structure to serve a subsuming role or to furnish ideational anchorage" (p. 158). Anderson, Spiro, and Anderson (1978) have provided a more precise description of Ausubel's notion of "ideational scaffolding" by relating a basic aspect of schema theory to it. In a very general sense, schema is an abstract representation of knowledge associated with a concept (Rumelhart and Ortony, 1977, p. 111).

Anderson, et.al.(1978) relate ideational scaffolding to schema theory by proposing that "a schema will contain slots into which some of the specific information described in a message will fit" (p. 434). They continue to suggest that "information that fits the superordinate schema is more likely to be learned and remembered, perhaps precisely because there is a niche for it" (p. 434).

Of special interest was a further proposition of Anderson, et. al. that "...information that matches slots in the schema would be said to be significant whereas information that does not would be called unimportant, irrelevant, or

in the limiting case - incongruous" (p. 434). In effect, they proposed as a general hypothesis that "information that is significant in the light of conceptual framework, or 'schema,' within which a text is interpreted ought to be better learned and recalled than less significant information" (p. 433). This hypothesis has been verified by several studies notably Mandler and Johnson (1977) and Brown and Smiley (1977).

An important implication can be drawn from this proposition. It is that when a reader is confronted with written discourse that is predominantly comprised of unfamiliar or new information, that reader is likely to have considerable difficulty learning and remembering the new information. This difficulty would be due to an absence of a sufficiently developed schema into which the new information can be assimilated. Further, this difficulty would be likely to increase if the unfamiliar information were predominantly comprised of very specific, detailed bits of information. It is precisely this implication that this study was designed to examine.

Problem

The problem that initiated this study was the inability of medical students to comprehend and recall the information presented in their medical texts. Specifically, the problem was identified among approximately fifty percent of the first year class of medical students at the University of Arizona College of Medicine. This problem, however, is hardly unique to that institution as Barnes, et.al. (1977) noted "...the ability to read effectively is not necessarily a part of the armamentarium of medical students."

Based on an examination of the primary textbooks used in various medical school courses, an analysis of the expectations demanded by medical school faculty, and a needs assessment inventory completed by the students themselves, several preliminary conclusions were drawn. First, the students themselves were identified as fluent, mature readers and students. Had the problem existed with only a small proportion of these students, other factors may have been considered, such as inappropriate admissions procedures; however these students had previously excelled in their academic careers and perceived themselves to be above-average readers. A second conclusion, based on an analysis of faculty-constructed tests, was that students were expected to know and recall very specific, detailed information about very complex issues. Finally, the information presented in the text, though logically organized, was also of a very detailed nature and was predominantly very unfamiliar to the students. In effect, then, these students were required to learn and retain information of a very specific nature for which they had limited previously-developed schemata.

Program

The proposed solution to the problem was to help the students construct some form of ideational scaffolding as they attempted to construct meaning from their texts. The instructional program that was designed focused on the use of reader-constructed structured overviews.

A structured overview is a graphic depiction of the "...hierarchical and parallel relationships among the concepts in the learning passage (represented in) schematic form" (Barron and Stone, 1974, p. 173). This device was first

developed by Barron (1969) and research related to its use has been most fruitful when students have designed a structured overview after reading a selection (Barron and Stone, 1974).

Given the research support for reader-constructed structured overviews after reading, it was hypothesized that readers could design such a graphic depiction as they read. While doing so, it was surmised that the reader would develop a visual, graphic "ideational scaffold" for the information conveyed in the text. By developing such an ideational scaffold, the reader would be able to identify hierarchical and parallel relationships among the concepts and, concurrently, generate a sufficiently developed schema into which additional information could be assimilated.

A major problem was immediately identified, however, that would interfere with this approach. The information included in the texts was sequenced hierarchically. That is, each chapter could be broken into three predominant hierarchical levels of information. On the highest level there were general, broad concepts that extended throughout the selection, usually limited to one, two, or three over-riding ideas. Related to these broad, general ideas were several major subordinate concepts that provided explication and elaboration of the general ideas. These were considered second order concepts and were labeled as such for instructional purposes. In addition to these two hierarchical levels of concepts were numerous specific and detailed pieces of information that provided the in-depth understanding that was emphasized by the faculty. The texts were typically presented in such a way that the general, over-riding concepts were introduced in a prefatory section at the beginning of the chapter. The author then proceeded to cover each of the major subordinate concepts individually and in extensive depth.

It was apparent that as students sought to understand the material, they would be likely to focus on one subordinate idea at a time along with the numerous detailed ideas that were presented hierarchically in relation to the subordinate idea. Such an approach would, to a degree, limit comprehension because the parallel relationships would only be developed tangentially as the students proceeded to subsequent subordinate ideas. In addition, many of the detailed, specific pieces of information did not become clear until the parallel relationships among the subordinate ideas were identified. Thus, to suggest that students progress through the text as it was presented would not be likely to increase their understanding even if they attempted to construct a structured overview as they read. In effect, they would not be able to construct a structured overview of each subordinate idea including the related specific details unless and/or until they first identified parallel relationships among the major subordinate concepts.

This problem was resolved by modifying the original plan to incorporate two separate, but related, bits of information. First, through the needs assessment inventory, the students themselves indicated that they read each chapter at least twice and, in most instances, three times. They further indicated that each time they read the material in the same way with the same purpose -- "to learn it all as well and as thoroughly as possible." This information was related to Frank Smith's suggestion that "...slowing down is not an efficient way to read if you are having difficulty comprehending. If you cannot comprehend..., let alone remember, you should try to read through faster, before worrying about the detail, in order to get the feeling of what entire passages are about" (1975, p. 251).

The instructional program utilized in this study was based upon the students reading each chapter three times. The first time they were to read inspectionally (Adler and Van Doren, 1972) to identify the overall, general ideas that were presented in the selection. Such a reading included the prefatory section; the diagrams, charts, and other visual aids; the first paragraph of each new subheading; and the summary. The second reading was intended to identify the gist of each subsection without concern for the detailed information. The intent was for the students to identify the major subordinate ideas within the selection and the parallel relationship among the major subordinate concepts. Further, the readers were to identify the hierarchical relationship between the general, over-riding concepts and the major subordinate ideas. During the final reading the students were to identify the specific, detailed information and the hierarchical and parallel relationships among the specific information itself and the other previously learned higher order concepts.

During each of the three readings of the selection, students were to construct on paper a structured overview as they read. With each subsequent reading, they added to, modified, and/or deleted information from their structured overviews.

Procedure

Eighty-four first year medical students in the College of Medicine at the University of Arizona were offered the program previously described. Thirty-six students requested the program and were randomly assigned to one of two groups.

For the purpose of this study, Group A (experimental group) was given a four week instructional program during February, 1978. Group B (control group) received no instruction during February, the time-span of the experimental treatment.

The instructional program for the experimental group consisted of four meetings of two hours per meeting. The first meeting included three topics. First, the problem was explained to the students so that they would understand what it was the program was intended to overcome. Second, the strategy was described for the students and each part of the strategy was related to aspects of the problem. Finally, the students were given a five-hundred word medical selection and told to practice the strategy. This practice session concluded with a discussion of the various structured overviews they constructed. Each subsequent meeting consisted of students practicing the strategy with material taken from medical texts that were part of current assignments and students then discussed their structured overviews. Medical faculty and the reading instructional staff were present at all meetings to provide assistance and feedback to the students.

Following the four instructional sessions, the experimental group was given a reading selection from their primary text for a course in neuroanatomy. This 3,684 word selection on the mesencephalon was one to be assigned them the following week.

An eight item, open-ended comprehension test was administered to the students upon completion of their reading. No time limit was placed on their reading or the comprehension test.

The test was designed by a team of five people consisting of two reading professors, two members of the medical faculty, and a measurements consultant. The test consisted of factual items that reflected each of the three levels of concepts previously discussed. That is, the test had three subparts comprised of broad, general concepts (15%), major subordinate concepts (30%), and specific detailed information (55%).

At the same time that this post-test was administered to the experimental group, it was also given to the control group (Group B). Since all students in both groups were in the same neuroanatomy class, they were all deemed to have the same background information and were at the same point in their academic program. (The control group subsequently received the same training program, but not until after this study had been completed.)

Results

A simple t-test was used to analyze the differences between the experimental and control groups. The mean percentage score for the experimental group was 74.91 (s.d. = 13.34) while the mean percentage score for the control group was 57.88 (s.d. = 15.38). This difference is significant at the .01 level ($t = 2.98$).

The subpart scores were also analyzed for differences between the groups. Again, a simple t-test was used to examine these differences. A repeated measures ANOVA was not used because there was an unequal number of items and percentage weight in the three categories. Since this was the case, a basic assumption of ANOVA would be violated.

In the higher level concept category (broad, general ideas), the mean percentage score for the experimental group was 97.0 (s.d. = 10) and for the control group was 81.3 (s.d. = 34). In the middle level concept category (major subordinate ideas), the mean percentage score for the experimental group was 86.4 (s.d. = 21) and for the control group was 74.2 (s.d. = 30). Neither of these differences were significant.

In the lower level concept category (specific, detailed information) the mean percentage score of the experimental group was 61.0 (s.d. = 20) and of the control group was 42.6 (s.d. = 13). This difference was significant at the .01 level.

One final result that may be of interest was that no significant differences were found in the words-per-minute for the reading task between the two groups. This is somewhat surprising given that most of the students in the experimental group were observed to construct on paper a structured overview as they read. One would surmise that the inclusion of such an additional task would have resulted in a significant difference in favor of the control group. Such was not the case.

Discussion

The results of this study indicate that medical students can improve their reading comprehension by constructing a graphic structured overview as they read. It seems that by doing so these readers are able to develop ideational scaffolds as they read and, in turn, such scaffolding provides them with sufficient superordinate schemata into which they can assimilate specific, detailed information.

It is of particular interest that the analysis of the subpart scores indicates that the experimental group was significantly different from the control group only in the area of specific, detailed information. This suggests that the control group was limited in their ability to process the information by the prior knowledge that existed at the outset of the reading activity. The experimental group, on the other hand, was able to process and retain the more detailed information because they relied on their understanding of the higher order concepts obtained through the first two readings.

The generalizability of this study is severely limited by the small number of students and the high academic ability of the participants. Given these limitations, further research is strongly encouraged with a broader range of students at various levels and, of course, with a more appropriate sample size.

Summary

Cognitive psychologists, notably those examining aspects of schema theory, have emphasized the importance of pre-existing knowledge as a determiner of reading comprehension. The results of this study suggest that readers can build ideational scaffolds during reading in the form of graphic depictions of the relationships among concepts.

Through the construction of such scaffolds, a reader can assimilate unfamiliar information more thoroughly than when conscious efforts are not made to identify ideational relationships. The assimilation of higher level information initially perceived as being unfamiliar can further provide a scaffold for the processing of more detailed information that otherwise may not be understood or retained.

The primary implications of this study are two-fold. First, information that may otherwise be perceived as being insignificant or incongruous can be processed when a reader constructs a more complete schema while reading. Second, a reader can develop a more complete scaffold within existing superordinate schemata by identifying hierarchical and vertical relationships and representing them graphically in a structured overview. Such an activity, then, seems to have important and valuable application in an instructional setting.

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